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GEOLOGY.—*Thorium minerals as age indicators.*[1] ROGER C. WELLS.

A mineral thought to be uraninite was found several years ago by a mineral collector, Geo. W. Gehman, of Bethlehem, Pa., in the Sherrer serpentine quarry just N.E. of Easton, Pa., which study in the U. S. Geological Survey has shown to be thorianite (Th, U)O_2.[2] Aside from its interest as the first authentic occurrence of thorianite in the United States the mineral raises some important questions as to the usefulness of thorium minerals as age indicators which I should like to discuss briefly.

Thorianite has heretofore been described only from Ceylon, Madagascar, and Siberia. It generally carries some, and the Easton specimen carries a large proportion, of uranium. Conversely many uraninites carry some thorium. As ThO_2 and UO_2 are isomorphous, thorianites and uraninites may be considered to form a series of solid solutions.

There has been a tendency to discard thorium minerals as age indicators when the figures obtained disagree with those yielded by uranium minerals. The mere fact of disagreement, however, is in itself no proof that thorium lead has been lost by leaching, as generally assumed. It would perhaps be equally fair to assume that uranium has been lost from the uranium minerals. Thorium minerals have generally been held to give too low figures for their age. R. W. Lawson thinks that they are in many places secondary minerals. Arthur Holmes[3] assumes that they are more easily altered than uranium minerals.

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[2] WELLS, R. C., FAIRCHILD, J. G., and ROSS, C. S. *Thorianite from Easton, Pa.* Amer. Journ. Sci. 26: 45. 1933.

[3] *The age of the Earth.* National Research Council Bull. 80: 213.

It is well known that many thorium minerals show evidences of alteration, but uranium minerals seem in general to be even more easily altered. Thorianite and monazite have been found in placer deposits, but no uranium mineral has been so found (with the single exception of brannerite, a titanate). Uraninite is generally much veined and most specimens are surrounded by various secondary alteration products. The off-hand evidence is therefore that uraninite is as easily if not more easily altered than monazite and thorianite.

Ellsworth and others have found that the most altered specimens of uraninite seem to give too high lead-uranium ratios, that is, that uranium is lost faster than lead. The excess of uranium oxide seems to protect and retain the lead. Likewise Baxter and Alter[4] report that Katanga pitchblende is traversed by numerous microscopic veins filled with yellow material soluble in dilute hydrochloric acid. The solutions that passed through these veins seem to have extracted uranium in preference to lead, for Pb/U of the yellow material is 0.144, against 0.089 for the black unaltered pitchblende. In a few instances uranium minerals and thorium minerals from the same rock give very good agreement in their age, two conspicuous instances of such agreement having been published by Fenner, viz. certain minerals from Brazil and from Connecticut, so that there can be little doubt that the fundamental mathematical factors of the calculations are essentially correct. In many cases, however, the agreement of results based on thorium and uranium is not good and the cause has usually been assigned to loss of thorium lead by leaching. Some writers even postulate a gain or loss of lead from minerals in the same district as best accords with the analytical figures.

The minerals of the Arendal district, Norway, have given special difficulty in this connection. Recent complete analyses of uranothorites (which are silicates rather than oxides) from the Arendal district by Gleditsch and Qviller,[5] with a determination of the atomic weight of the lead, offer facts for discussing this question. They found the separate percentages of uranium lead and thorium lead in the same mineral and the following ratios which should be identical after reducing thorium to its uranium equivalent:

$$\frac{\text{Radium G}}{\text{Uranium}} = 0.05656 \qquad \frac{\text{Thorium D}}{\text{Thorium}} = 0.03206$$

[4] Science, 77: 431. 1933.
[5] Phil. Mag. 14: 233. 1932.

The ratios also are low for the district, compared with those of uraninites. The authors conclude: "These different facts are most easily explained by accepting Professor Holmes's suggestion that thorium minerals have been subject to a leaching-out by ground waters and that this leaching has more particularly affected the thorium-lead."

Against this conclusion are the arguments cited above. It also assumes a separation of isotopes by leaching from a single mineral, something not impossible perhaps, but generally contrary to geochemical experience, as isotopic mixtures have heretofore always been found in remarkably constant proportions everywhere in nature, except when genetically related to a parent element in a mineral. Obviously an alternative to this explanation is to assume a loss of uranium by leaching, following Ellsworth.

The use of atomic weight figures in solving this problem seems reasonably sound. For example, ordinary lead from whatever source the world over gives essentially the same atomic weight, indicating an old and thorough mixing of its isotopes. The evidence for the uniformity of uranium lead and thorium lead is not so ample but, on the other hand, there is at present little evidence against such a view in the case of older minerals. The lead from carnotite, however, does not seem to be pure uranium lead. These matters are discussed in detail by Holmes in Bull. 80 of the National Research Council and cannot be fully covered in a brief paper. The principal point that I wish to make is that lead isotopes cannot be assumed to have been separated by leaching from the same mineral, and the alternative seems to be that uranium has been leached relatively to the other elements.

What is the correct age of such minerals as the Arendal uranothorites? If uranium has been removed relative to lead, as in the altered uraninites, according to Ellsworth, the correct lead-uranium ratio should be lower. A loss of lead would affect both ratios and they should both be greater, but this could not bring the uranium and the thorium ratios into agreement. It therefore seems to me reasonable to accept the lower ratios and shorter ages in at least some of the cases where there is a difference. Thus, some of the minerals in the pegmatites of the Arendal district, based on their lead-thorium ratio would be of late Paleozoic age although the rocks of the district are thought to be pre-Cambrian.

In general the origin of the pegmatites and the condition of the specimens analyzed should also be carefully studied and described. Apparently some thorites have such small percentages of lead that

they are valueless as age indicators, or else they are of very recent formation.

The changes here indicated need not for the present affect the ages of minerals back to the Paleozoic. In the Paleozoic we should consider carefully the stage of alteration of the mineral. In pre-Cambrian minerals we may well be skeptical of the very old ones which have had to undergo the effects of many varied geologic changes.

Fortunately we have some independent checks on the lead method of computing the ages of minerals. Bradley, from a study of varves is able to extrapolate a figure for the length of the Eocene which harmonizes with that deduced by the lead method, as Schuchert has pointed out. Of course this cannot be extrapolated very far, but with further study of all the different methods of estimating geologic time we may hope for better general agreement on the main features of the problem.

SUMMARY

Some reasons are given for ascribing more weight to thorium minerals as age indicators than they have heretofore received. In uranothorites, it was argued, the lead isotopes would not be separated by leaching, so that a loss of uranium would have to be postulated to bring the RaG/U and ThD/Th ratios in agreement.

BOTANY.—*Sex and accessory cell fusions in the Uredineae.*[1] C. F. ANDRUS,[2] Bureau of Plant Industry. (Communicated by L. L. HARTER.)

INTRODUCTION

A number of contributions have been made to the study of fertilization in the Uredineae (1) (2) (3) (10) (15) since the writer (4) first published evidence that spermatium nuclei enter the tips of superficial hyphae and migrate to the haploid cells of the aecial primordia. The new contributions have chiefly corroborated the observation that spermatium nuclei enter the exposed gametophytic hyphae. The further progress of the spermatium nuclei and the process by which they eventually become paired with individual nuclei of the aecial primordium has escaped the scrutiny of these observers. Likewise, there is still lacking an adequate interpretation of those cell fusions

[1] Received August 8, 1933.

[2] Grateful acknowledgment is made to Dr. L. L. Harter, who has provided facilities for research and advised in the preparation of the manuscript.

and apparently miscellaneous nuclear migrations in the young aecium that are so commonly associated with the act of fertilization.

The writer has recently had occasion to examine a number of slides of the bean rust, *Uromyces appendiculatus* (Pers.) Fries, and the cowpea rust, *U. vignae* Barclay, some of them prepared after the earlier communication was submitted for publication. In a number of instances details of the obscure fertilization process appeared on these slides with unusual clarity and it is believed that these observations are of sufficient interest and value to deserve some record. The new observations will emphasize more strongly that the relation between spermatium and receptive cell in the aecium of Uromyces is a true sperm-egg relation, and will indicate in addition that certain cell fusions which accompany diploidization in the aecium are an important accessory to the fertilization process. In conclusion it is proposed to discuss the possible bearing of the newly observed phenomena of sex and organography in the Uredineae upon the general problem of sex in fungi.

THE ENTRANCE AND MIGRATION OF SPERMATIUM NUCLEI

Attention has been given to a more detailed examination of the means by which spermatium nuclei reach the aecium from their point of entrance at the host epidermis. A first fact worthy of comment is the apparent ease with which the nuclei disregard the numerous crosswalls in their passage through the often intricate maze of mycelial strands. This fact has been verified by the observation that the spermatium nuclei can be made to contrast strongly with the ordinary or indigenous cell nuclei of the gametophytic mycelium and thus can be identified at various points throughout the infected area. Contrast in stain has been obtained with the triple combination of safranin, gentian violet, and orange G on material fixed in Carnoy's and in Fleming's weaker solution.

When revealed by a good differentiation of stain the spermatium nuclei display a curiously compact structure which differs markedly from the structure of the indigenous cell nuclei. Figure 1, C, G, H, I, and L shows this difference in structure and indicates the difference in intensity of stain. The normal or indigenous cell nuclei show reticulation outlined in gentian violet, which is frequently very distinct in the greatly enlarged egg nuclei. A conspicuous nucleolus is invariably present in the (basal cell) nuclei and frequently is equal in diameter to the spermatium nucleus at the time the latter has just entered

the basal cell. The nucleoli retain the safranin stain, but often with a pale center giving somewhat the appearance of a vacuole. (Fig. 1, K, *c*.) Spermatium nuclei rarely show reticulation but are stained richly, with gentian violet predominating, and contrast in brilliance with the dull safranin of the egg nucleoli. An eccentric position of the deeply stained portion is a common characteristic of the spermatium nuclei at this stage. The stainable portion is frequently crescent-shaped (fig. 1, J, L) or comma-shaped (fig. 2, C, D); a faint edging or halo (fig. 2, F, *b*) often gives them a curiously detached appearance. The distinctive appearance of the spermatium nuclei is lost during the first conjugate division with egg nuclei.

Having observed the characteristic structure and staining properties of the newly introduced spermatium nuclei, it is possible to observe these bodies in their devious progress through the crosswalls of the trichogenous hyphae and in the act of migrating between adjacent cells of the fertile layer in the aecium. Figure 1, A and B, shows fusion of spermatia with the tips of superficial hyphae. Figure 1, D to F, shows spermatium nuclei in process of migration through hyphal crosswalls. Many such cases have been observed. In Figure 1, G, is shown a spermatium nucleus as it maneuvers past the cell nucleus in its passage through the trichogenous hypha. Spermatium nuclei after they have reached the base of the aecium are shown in Figures 1 and 2. Figures 1, J, K, and 2, A, show migration between continuous and between adjacent cells at the base of the aecium. On certain slides these can be seen with great frequency.

It is necessary to conclude that cell walls furnish remarkably little inconvenience to the movements of nuclei. Whether passage through the walls is secured by dissolution, or by openings normally present, or whether the forces causing the movements of the nuclei are sufficiently potent to cause mechanical rupture, is not entirely apparent from the observations made. From the appearance of the crosswall after passage of the nucleus shown at *e* in Figure 2, I, it would seem

Fig. 1.—Entrance and migration of spermatium nuclei of *Uromyces appendiculatus*, A, E to G, J to M, and *U. vignae*, B to D, H, I. ×1500. A, B.—Fusion of spermatia with gametophytic hyphae. C.—Spermatium nucleus (*a*) contrasted with cell nucleus (*b*). D to F.—Migration of spermatium nuclei (*a*) through crosswalls of trichogenous hyphae; cell nuclei at *b*. G.—Indigenous cell nucleus (*a*) in a conducting hypha allowing a spermatium nucleus (*b*) to maneuver past on its way to the aecium. H.—Contrast of spermatium (*a*) and cell nucleus (*b*). I.—Initial fertilization of a basal cell; spermatium nucleus at *a* and egg nucleus at *b*. J.—Entrance of spermatium nuclei (*a*, *b*, *c*) into basal cells. K.—Entrance of spermatium nuclei (*a*, *b*) into basal cells; the egg nucleolus (*c*) is often similar in size to spermatium nuclei but differs markedly in stain. L.—Early relation of egg (*a*) and spermatium (*b*) nuclei. Note orientation of the egg nucleus as compared to I. M.—Entrance of spermatium nuclei (*a*, *b*) into basal cells. The normal cell nucleus is shown at *c*.

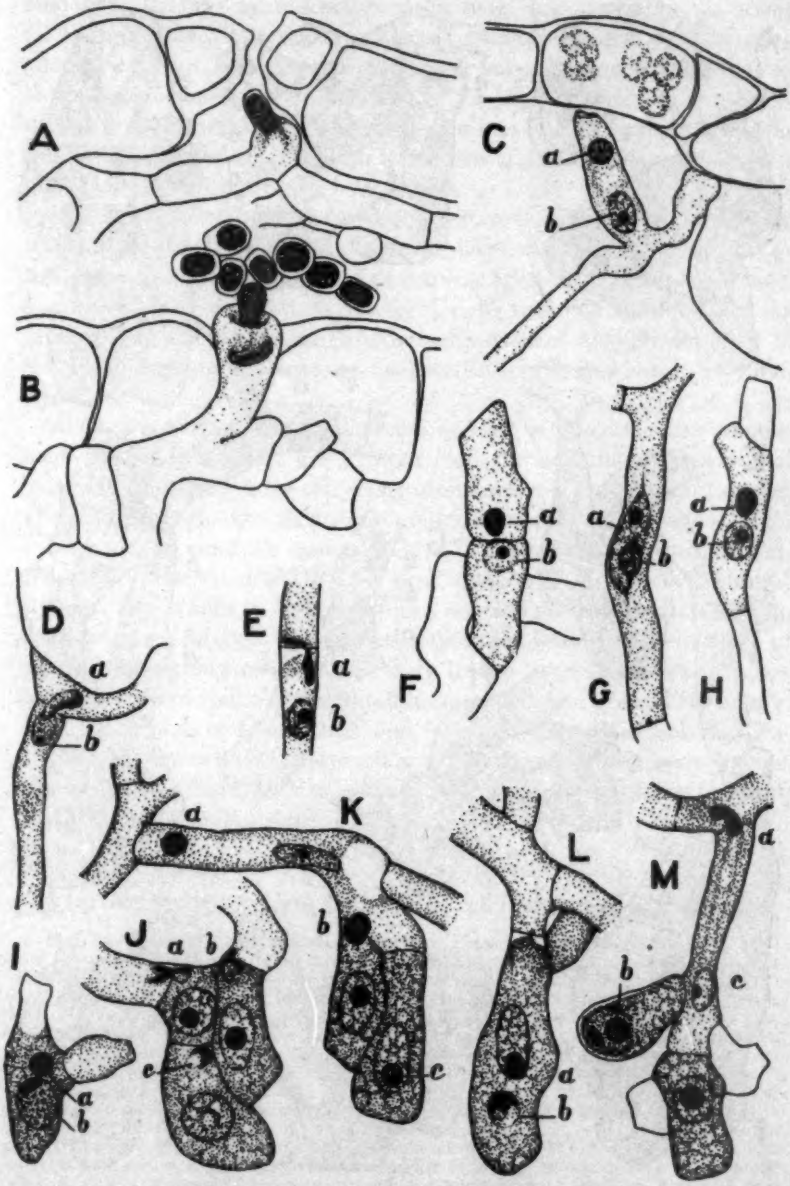

Fig. 1.—For explanation see opposite page.

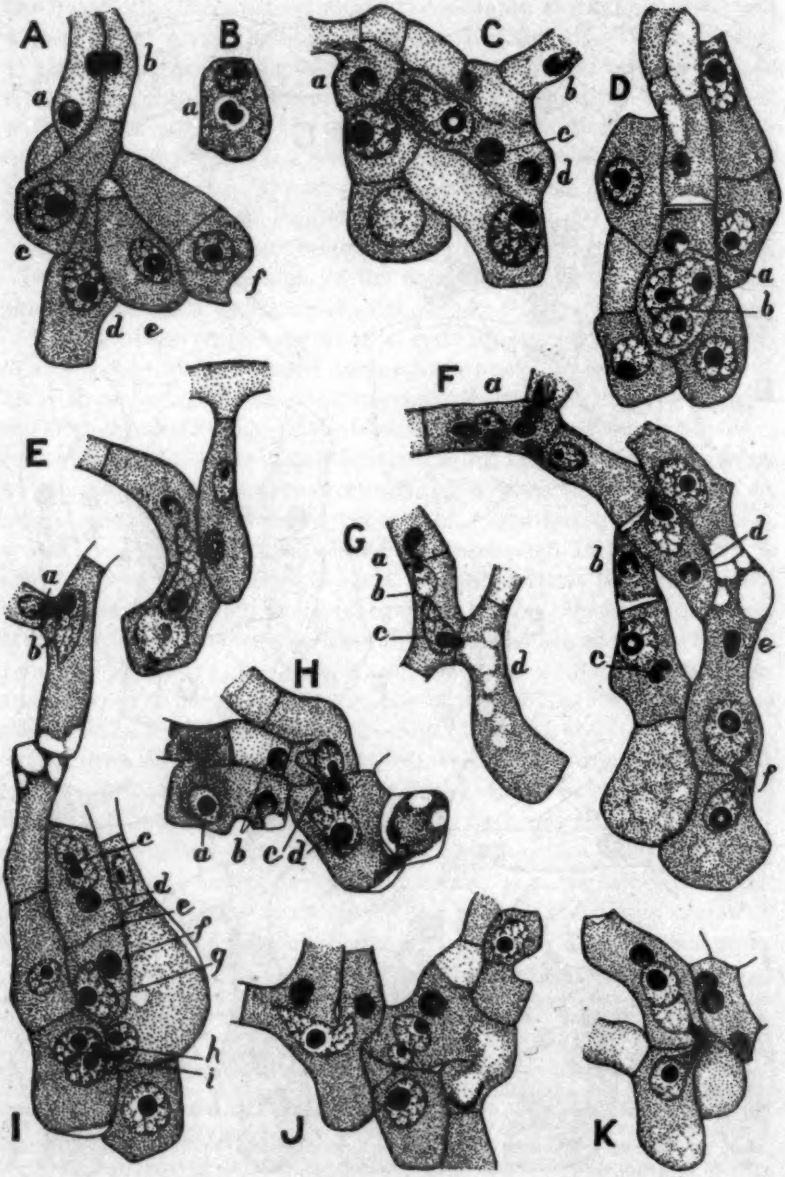

Fig. 2.—For explanation see opposite page.

that the wall has been forcibly ruptured,—less probably dissolved. In Figure 1, M, the nucleus (*a*) is not enough constricted to suggest that its passage is restricted to a small pore. However, Figure 1, E, shows a nucleus much constricted in its passage through the cross-wall. Furthermore, it is clear that a pore is commonly present in these hyphal crosswalls, even though it is not certain that the presence of a pore facilitates migration of the nuclei.

It is apparent from the evidence just presented that spermatium nuclei migrate through gametophytic hyphae from the epidermis to the aecium, and these conducting hyphae are still gametophytic after passage of the spermatium nuclei. Up to this point, therefore, the process of fertilization offers little suggestion of any relationship to the diploidization process supposed by Buller (8) to occur in Hymenomycetes.

Allen (1) suggested that in some species of *Puccinia* the aecium may be diploidized by the growth into the aecium of sporophytic hyphae originating near the point of entrance of spermatium nuclei. She even thought she saw some evidence of this on her slides of *P. triticina* Eriks. and *P. coronata* Cda. (2). Such a procedure is conceivable and even probable for such species as *P. caricis* (Schum.) Rebent. where cells of the hymenium are observed to be diploid from their origin (13), but there is no indication that such a method of diploidization may occur even rarely in the bean and cowpea rusts. Aggregations of well differentiated haploid cells are present in definite localized regions of the thallus, and fertilization of these cells is initiated by the entrance of spermatium nuclei. There is no reason to conclude that this is not as true a sperm-egg relation as is to be found in any group of Thallophytes.

ACCESSORY CELL FUSIONS IN THE AECIUM

A further study has been made of the cell fusions and nuclear migra-

Fig. 2.—Nuclear relations in the aecium of *Uromyces appendiculatus*, A, C to K, and *U. vignae*, B. ×1500. A.—Entrance of spermatium nuclei (*a*, *b*) at base of aecium; egg or basal cell nuclei are shown at *c* to *f*. B.—Possible division or fragmentation of a spermatium nucleus (*a*) after it has entered a basal cell. C.—Spermatium nuclei (*a* to *d*) showing evidence of division and migration. D.—Spermatium nucleus (*a*) in a basal cell with 3 egg nuclei (*b*). E.—Migration of an egg nucleus toward an approaching spermatium nucleus. F.—Migration of spermatium nuclei through a series of conducting cells. Note migration of the egg nucleus (*f*) from the terminal cell of the series. A normal cell nucleus is shown at *a* with several spermatium nuclei; spermatium nuclei also at *b* to *d*. G.—Spermatium nucleus (*a*) approached by a normal cell nucleus (*b*) and an egg nucleus (*c*) which has vacated the basal cell (*d*). H.—Nuclear migration at base of aecium; egg nuclei at *a*, *c*, *d*, and spermatium nuclei at *b*. I.—Migration of both spermatium and egg nuclei; spermatium nuclei at *a*, *d*, *f*, and probably *i*; egg nuclei at *b*, *g*, *h*; *c* is probably a recently divided egg nucleus; note ruptured crosswall at *e*. J, K.—Migration of egg nuclei after entrance of spermatium nuclei.

tions that occur within the aecium immediately following the first stage of fertilization. It appears that the fertilization process does not cease with the entrance of a particular spermatium nucleus into a particular egg cell; there occur divisions of the egg nuclei and probably also of the spermatium nuclei, which are followed by further migrations of both spermatium and egg nuclei. As a result numerous originally uninucleate cells are diploidized following entrance of only a few spermatium nuclei. Some suggestion of this was made in an earlier publication (4). It is believed to be possible that in the accessory cell fusions and nuclear migrations there may be found a process in some degree comparable to the diploidization in Hymenomycetes.

It is necessary to distinguish at least two types of cell fusion in the aecia of *Uromyces*, fusions that are undoubtedly stimulated by the entrance of spermatium nuclei, and fusions that occur in aged sterile aecia showing evidence of degeneration. Fusions of the second type, in their advanced stages, involve an almost general dissolution of cell walls accompanied by a multiplicity of small nuclei, often inadequately stained. Allen (2) illustrates fusions of this type for *Puccinia coronata*. They occur regularly in unfertilized infections of bean rust. Migrations of nuclei through small openings are characteristically absent from such material. Initial stages in degeneration of sterile aecia may show fusions that are not clearly distinguishable from fusions that accompany fertilization. It may be stated generally, however, that cell fusions in a sterile aecium involve a general disorganization of cell partitions, whereas fusions associated with fertilization involve nuclear migrations with only local dissolution or rupture of cell walls.

The explanation of cell fusions associated with fertilization in bean and cowpea rusts is then largely a problem of interpreting the nuclear migrations that accompany or follow entrance of spermatium nuclei into the aecium. It appears that the nuclear migrations involve movements of both spermatium and egg nuclei. The difficulty in deciding this point is increased by the fact that spermatium nuclei no longer show the characteristic structure and stain after the first conjugate division. Consequently many of the migrating nuclei which appear to have the structure of an egg nucleus may in fact be of spermatial origin.

Material fixed at an early stage in fertilization will frequently show basal cells with a very nearly ideal relation of egg and spermatium nuclei. Such a one is shown in Figure 1, I. So far as could be determined this is the first spermatium nucleus to enter this aecium. The

figure is drawn from a 16 day infection fixed very soon after spermatia were transferred on the surface of the host leaf. The figure certainly suggests a typical sperm-egg relationship, comparable, for example, to the fertilization of an egg in the archegonium of a fern. Figure 1, L, is only a little less convincing in this respect. Of possible significance is the apparent shift in position of the egg nucleolus, which in this case corresponds to the relative position of the spermatium nucleus in the two figures. Fertilization, however, is not ordinarily so simple as would be indicated by these two figures. There is evidence that the spermatium nuclei may divide soon after entering the first basal cell, as appears to be the case in Figure 2, B. The division, if it is such, would appear to be amitotic. Figure 2, A (*b*), may represent such a division occurring at the cell partition. Also the two distinct spermatium nuclei (*c*, *d*) represented in Figure 2, C, may have entered separately but quite as probably are the result of a nuclear division.

The egg nucleus also appears frequently to undergo division, just preceding or immediately following entrance of the spermatium nucleus. That the first divisions of spermatium and egg nuclei are not simultaneous is evidenced by Figure 2, B, as well as *a* and *f* of Figure 3, A. The migration into an adjacent basal cell of one portion of a recently divided spermatium nucleus is suggested in Figure 2, I, although again it should be stated that the spermatium nuclei shown (*d* and *f*) may be of separate origin. That egg nuclei also migrate from cell to cell during this period is evidenced in Figures 2 and 3.

The presence of 2, 3, and occasionally 4, egg nuclei in a single basal cell is a common observation at an early stage in fertilization. The explanation would appear to be that the approach of spermatium nuclei is a stimulus that promotes movement of egg nuclei. This is suggested in Figure 2, G, where the egg nucleus (*c*) has completely vacated the basal cell (*d*) and entered the conducting hypha where the smaller cell nucleus (*b*) already appears to be assisting the approaching spermatium nucleus (*a*) through the narrow aperture in the crosswall. Also in Figure 2, F, where the approach of several spermatium nuclei appears to have exerted some force upon the nucleus in the most terminal unfertilized cell. Again in Figure 2, E, and H to K, and Figure 3, A, migrations of egg nuclei are occurring at several points, but usually in a direction toward spermatium nuclei. Curiously the 2 egg nuclei in Figure 3, B, appear undecided which way to move. Not all instances of this sort lend themselves to interpretation.

The movement of egg nuclei toward the approaching spermatium nuclei may be due to a definite attraction between the two kinds of bodies or it may be merely incidental to a general cytoplasmic movement which has the effect of concentrating the active protoplasmic substances in the fertile layer of the aecium. A general cytoplasmic movement toward the fertile layer would result in the withdrawal of nutritive materials from the sterile portion of the aecium and likewise

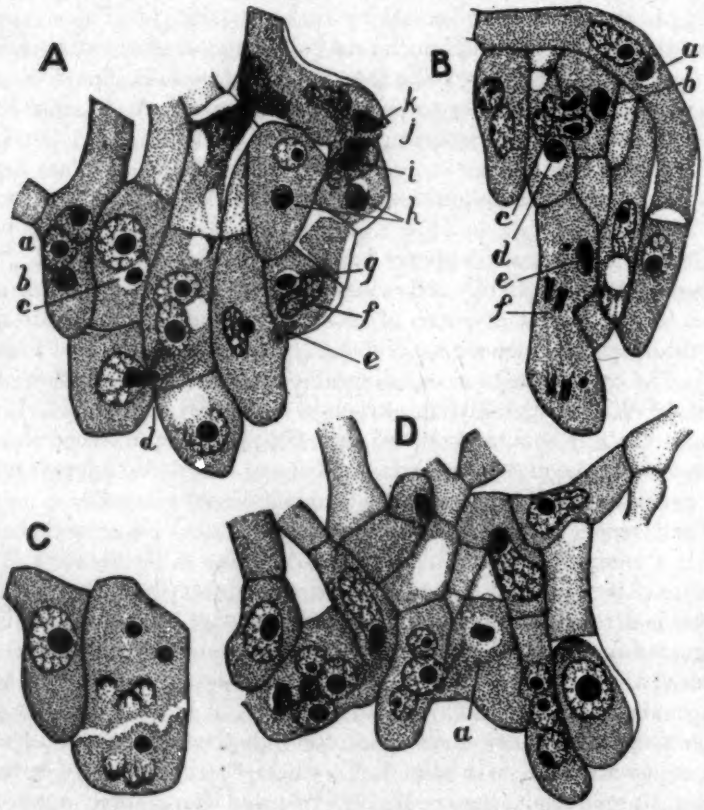

Fig. 3.—Nuclear division and migration in *Uromyces appendiculatus*, A, B, D, and *U. vignae*, C. ×1500. A.—Recently divided egg nuclei at *a* and *f*; spermatium nuclei at *b*, *c*, *g*, *h*, and *k*; cell fusions at *d*, *e*, and *j*; egg nucleolus at *i*; migration at *d* may involve either a spermatium or an egg nucleus. B.—Migration of egg nuclei at *c*; spermatium nuclei shown at *a*, *b*, *d*, and *e*; the conjugate division at *f* probably involves only egg nuclei. C.—Division of a trinucleate basal cell. D.—Cell fusions with evidence of nuclear migrations at several points. An adjacent section shows an egg nucleus and a second spermatium nucleus in the cell at *a*.

might conceivably draw spermatium nuclei from the peripheral hyphae toward the aecium. Whatever may be the force causing migration of egg nuclei from an unfertilized cell into a fertilized cell, such migration would appear to have a nutritive effect and would support later proliferation of the multinucleate basal cell. The cell fusions and nuclear migrations observed in the aecium of *Uromyces* obviously correspond to those described by Blackman (6) and Christman (9) for numerous species of Uredineae; and, although they are not gametic fusions in the sense proposed by the above authors, they do appear to be an important and perhaps characteristic accompaniment of the sexual act.

Migration of egg nuclei is frequently from an unfertilized cell into a cell which has just received or is about to receive a spermatium nucleus. This in certain instances accounts for the multinucleate condition of newly fertilized cells. (Fig. 2, D, I, and K.) In other instances (fig. 3, A and D) the multinuclear condition is probably the result of nuclear divisions that occur previous to the familiar conjugate divisions. Upon this basis it cannot always be inferred that two nuclei in a binucleate basal cell are necessarily of separate origin or of different sex. It is probable that the conjugate division shown in Figure 2, B, involves nuclei neither one of which is of spermatial origin. Later divisions of this basal cell would probably involve the spermatium nucleus shown at *e*.

Some observations have been made concerning the fate of the excess nuclei after spore formation is begun. Reduction to the single pair of nuclei that is so characteristic in cells of a mature aecium may be accomplished by any one of four methods. 1. By eliminating the extra nuclei in the first spore abstricted. 2. By migration of extra nuclei into adjacent unfertilized cells. 3. By degeneration of one or more nuclei. 4. By proliferation of the basal cell into two or more spore chains. There is evidence that all four methods are actually followed at various times. Frequently, as in Figure 3, C, a few basal cells continue to produce spores with more than two nuclei.

It is evident from the above that great irregularity characterizes the nuclear behavior in a fertilized rust aecium. The apparently miscellaneous nuclear divisions and migrations have the result, however, of securing the diploidization of numerous basal cells by means of a comparatively few spermatium nuclei. In this procedure there is some suggestion of the diploidization process in Hymenomycetes, where it is supposed (8) that a single nucleus of one sex can diploidize a whole thallus of different sex. In respect to the two species of *Uromyces* here

concerned, it would be a mistake to suppose that the whole rust thallus is comparable to the thallus of a Hymenomycete. For here, at least, the whole thallus is not diploidized by the spermatium nuclei, but only definitely differentiated gametic areas of the thallus. Surrounding hyphae serve as conducting channels for spermatium nuclei but remain haploid after passage of the nuclei.

DISCUSSION

The present communication emphasizes the earlier observation (4) that fertilization of a haploid aecium by entrance of spermatium nuclei in *Uromyces* constitutes a true sperm-egg relation. It can scarcely be denied that each gametophyte of *Uromyces* produces organs that not only function as gametes but have some of the morphological peculiarities of the sperm and egg mechanisms of certain more familiar plants. It would be unwise, however, to emphasize any apparent homologies with the sperm-egg mechanisms of any other group of organisms.

Some confusion has resulted from the paradox offered by fungi of this type, wherein a full complement of "sex" organs are present on individuals of both "sexes." A comparable situation has long been familiar to students of flowering plants; but botanists have never looked upon non-compatibility groups of flowering plants as being sexual groups. Sperm and egg mechanisms, as conceived by the writer, are a part of the characteristic organography of particular species and are frequently independent of the physiological condition of individuals in respect to compatibility. This viewpoint seems to be demanded by the newly observed facts of sex segregation and organography in fungi. Many species that would be homothallic in respect to sex organs are in fact heterothallic in respect to sexual compatibility. Furthermore, it is probable that in certain species that appear to be typically homothallic (and self-fertile) the development of fruiting bodies may proceed parthenogenetically or without any reaction between the sperm and egg mechanisms present (5). Such a homothallic species is in fact unisexual.

Dodge (11) has explained in considerable detail how the sexes segregate in the ascus of *Neurospora* so as to form unisexual strains (of heterothallic forms) and bisexual strains (of homothallic forms). He presumes that a unisexual strain consists of individuals that correspond to either sperm-producers or egg-producers, while the bisexual strain consists of individuals that produce both sperm and egg mechanisms. In the case of certain rust fungi and Ascomycetes,

mycologists are forced to an embarrassing conclusion, for here the "sexes" (organs) are obviously segregated in the vegetative divisions of the gametophyte while the conditions of maleness and femaleness (the factors for copulability) are segregated in the nuclear divisions in the ascus and in the basidium. Which of the two above relations is actually segregated in the ascus of *Neurospora*? More recent observations on this fungus (12) would seem to indicate that copulability factors are segregated in the ascus and that the strains which, according to Dodge (11), are unisexual are in fact producers of both sperm and egg mechanisms. Uredineae of the *Uromyces* type are similar to *Neurospora* in that respect.

There is some inclination to look upon sex phenomena in the Uredineae as comparable in many respects with the diploidization process in Hymenomycetes as postulated by Buller (8). Undoubtedly there are points of similarity. Buller indicates how, "in a very simple way," a diploid cell can fertilize a haploid cell, and how the diploidization may continue progressively so that a whole haploid mycelium may be diploidized,—presumably by the entrance into one haploid cell of a single nucleus of opposite sex. There is no evidence from Buller's researches that fertilization by a diploid mycelium is not preceded by a type of reduction. Vandendries and Martens (16) have shown that haploid oidia are formed by diploid mycelia of *Pholiota aurivilla* Batsch, and it is conceivable that this may be a common procedure in other Hymenomycetes. Likewise, Brown (7) presents no evidence that haploid cells are not formed by the rust sporophyte immediately preceding fertilization of a gametophytic mycelium of *Puccinia helianthi* Schw. These announcements show the inadequacy of methods of research in this field which do not include a study of cytological phenomena.

On the other hand, there is perhaps nothing remarkable in the fact that a diploid (or binucleate) cell can fertilize a haploid cell, or that fertilization can occur in any combination whatsoever, providing the necessary sexual gradient exists between the nuclei concerned. On the preceding pages there is described what is believed to be such a process taking place in the aecium of *Uromyces*. By means of nuclear division and migration a single spermatium nucleus is sufficient to fertilize numerous basal cells. Diploidization in *Uromyces*, however, is restricted to specially differentiated gametic areas. In this respect, and in other details, it contrasts strongly with the scheme of diploidization outlined by Buller (8), which apparently is based largely upon the cytological work of Lehfeldt (14).

Buller (8) has attempted to draw a fundamental distinction between the processes of fertilization in Hymenomycetes and in higher plants. The cells which become diploid in Hymenomycetes are not egg cells, Buller conceives, for the whole haploid mycelium should be looked upon as a multicellular egg. Likewise, according to this author, the haploid cells (oidia) which frequently initiate fertilization are not sperm cells, for they too are capable of independent growth and of forming a multicellular individual. This is an ingenious theory. At the same time it might as easily be conceived that the fern gametophyte is a multicellular egg, but upon this multicellular individual there are usually developed characteristic structures which bear the relation of sperm and egg mechanisms. This is quite as true of the rust gametophyte. In the fern gametophyte as well as in the fungus gametophyte fertilizations are not restricted to these differentiated structures.

Sperm and egg mechanisms in all their variations may be looked upon as a part of the characteristic organography of particular species. They may be no more male and female than any two other organs of the individual. In many of these species they are a means by which alone diploidization is possible. In other species the cellular anatomy may be such that sexual unions are not restricted to any specially differentiated cells, even though such be present and functional. The new observations on sex in fungi have revealed little concerning the nature of sex, but they have brought into question the arguments of those who seek to place in different categories gametic unions occurring between undifferentiated cells and those occurring between cells differentiated as sperm and egg. Apparently both types of fertilization occur in the rust fungi.

SUMMARY

Continued observations on fertilization in two species of *Uromyces* emphasize the view that the relation between spermatium and haploid basal cell is a true sperm-egg relation.

The structure and staining properties of migrating spermatium nuclei are described and contrasted with those of nuclei in the conducting strands and in basal cells of the aecium. By means of this contrast it is possible to identify spermatium nuclei at various points within the gametophyte thallus.

The fusion of spermatia with superficial hyphae and the passage of the spermatium nuclei through the conducting strands is described in some detail. The trichogenous hyphae remain haploid after passage of the spermatium nuclei.

Cell fusions that occur in sterile (unfertilized) aecia are distinguished from those occurring at the time of fertilization. Fusions of the first type involve a general disorganization of cell partitions while fusions of the second type are incidental to nuclear migration with only local dissolution or rupture of cell walls.

The period of fertilization is accompanied by migrations of both spermatium and egg nuclei, both of which are believed to divide independently during the initial stage. Migration of egg (basal cell) nuclei appears to be related to the approach of spermatium nuclei. A number of significant details in the relations of spermatium and egg nuclei are described.

The nuclear migrations in the aecium are believed to represent a process of diploidization that may be remotely comparable to diploidization in Hymenomycetes.

The discussion covers the possible bearing of sex phenomena in the Uredineae upon the larger problem of sex in Thallophytes.

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BOTANY.—*A new* Gossypium *of Lower California.*[1]

THOMAS H. KEARNEY, Bureau of Plant Industry.

In 1931, as guests of Mr. Allison V. Armour, G. N. Collins, J. H. Kempton and the writer participated in a cruise in the Gulf of California. Seeds of *gossypium harknessii* Brandegee were collected on Carmen Island and, of what was supposed at the time to be a peculiar form of the same species, on San Marcos Island. Through the courtesy of Mr. and Mrs. E. H. Page, resident on the latter island, an abundant supply of seeds was received later. Plants were grown in California from these several lots of seed; and it became apparent, almost immediately, that the San Marcos Island plant is very different from typical *harknessii*, as represented by the Carmen Island collection.[2] Plants of both forms flowered and fruited at several stations in southern California in 1933. Comparison of these living plants, growing side by side, left no room for doubt that the plant of San Marcos Island is a quite distinct species. It has not, apparently, been described previously, although herbarium specimens were collected at the same locality by Ivan M. Johnston, as a member of the expedition of the California Academy of Sciences to the Gulf of California in 1921.

It is a pleasure to name this attractive little shrub in honor of Mr. Allison V. Armour, whose generous cooperation has enabled the Department of Agriculture to introduce valuable plants from many parts of the world, and who made it possible to obtain the evidence that the San Marcos Island plant is a new species of *Gossypium*.

Gossypium armourianum, sp. nov.

Frutex ramosissimus, ramis patulis vel adscendentibus, praeter corollam, capsulae partem interiorem, et semina mox glaberrimus; lamina folii crassa, nitida, 2–3.5 cm. longa et subaequilata vel latior, non lobata, subcordata, apice obtusa vel acutiuscula et saepe mucronata; pedunculus anthesi 2–4 cm. longus, subclavatus, sine nectariis; involucellum caducissimum, bracteolis 2–5 mm. longis distinctis subulatis integris; calyx 5-dentatus, dentibus 1–2 mm. longis, triangulis vel subulatis; petala 2.5–4.5 cm. longa, sulfurea, maculam conspicuam rubram ferentia vel nonnunquam immaculosa; filamenta 2–4 mm. longa, tenua; antherae ca. 1 mm. longae; styli et stigmata 20–25 mm. longa; ovarium 3–4-loculatum, loculis plerumque 3-ovulatis; capsula 10–20 mm. longa, ovoidea, abrupte acuminata vel interdum solum apiculata, intus margine valvarum glabra vel pilis raris longis debilibus ciliata; semina loculo quoque 1–3, 7–9 mm. longa, saepe solide connata, obovoidea, angulata, pilis appressis crispatis subfulvis dense pilosa.

[1] Received November 11, 1933.

[2] The difference was noticed, in the early seedling stage, by C. G. Marshall, Superintendent of the U. S. Acclimatization Garden, Torrey Pines, Calif.

Characters not stated in the preceding diagnosis are as follows: Shrub compact, broader than high, with the main stem or leading branch attaining a length of 115 cm. and a diameter at base of 2.5 cm., obscurely granular-puberulent on the very young parts, including the caducous stipules and involucel, dotted with slightly prominent, brown (drying black) oil glands on the twigs, stipules, petiole, midvein of leaf dorsally near base, peduncle, involucel, calyx, petals, column, exserted portion of pistil and capsule; twigs reddish and more or less glaucous, older bark reddish-brown; stipules 1.5 to 2.5 mm. long, subulate, soon deciduous; petiole slender, as long as or slightly longer than the blade, usually dark red toward apex; leaf blades dark green, with a very small greenish or brownish pulvinus, punctate with imbedded, dark brown oil glands, rounded-deltoid, often 1.5 times as wide as long, crenulate, the basal sinus open and broadly triangular, palmately 5-veined, with a small deltoid or lanceolate nectary near the base of the midvein, dorsally; flowers borne (usually singly and often as if terminally) on very short, spreading or ascending branchlets, to which the peduncle is articulated; involucel caducous long before anthesis, usually when the flower bud is not more than 6 mm. long; calyx 5–10 mm. high at anthesis, copiously dotted with oil glands; petals at apex about as wide as long, with upper margin slightly erose, often puberulent (and reddish) on the dorsal surface where exposed in bud, ciliolate above, ciliate towards base, densely so on the very short claws with hairs 1–2 mm. long, pale green-yellow,[3] the subbasal spot, when present, 5–10 mm. long, solid or striate, carmine; column staminiferous one-third to two-thirds of its length; stamens with pale orange anthers, the enlarged summit of the filament carmine, pollen orange-yellow; pistil with the exserted portion usually longer than the column and conspicuously dotted with reddish brown oil glands; stigmas erect, closely connate; capsule usually sharply acuminate with the point 1 to 5 mm. long, pale green before maturity, conspicuously dotted with oil glands much larger than those of the calyx; seeds rather narrowly obovoid, rounded-convex on the back, usually flat on the inner face or faces, coffee-colored, the hairs pale brown and attaining a length of about 4 mm.

TYPE LOCALITY: San Marcos Island, near the eastern coast of Lower California, latitude 27° 15′N. Type in the U. S. National Herbarium, no. 1,184,705, collected by T. H. Kearney, August 25, 1933, at Palm Springs, California, from a plant grown from seeds from San Marcos Island.

GEOGRAPHICAL DISTRIBUTION: Known only from the type locality.

SPECIMENS EXAMINED: San Marcos Island, *Johnston* 3645; *Collins, Kearney & Kempton* 251. Also living plants in the U. S. Department of Agriculture collections at Riverside, Palm Springs, and Bard, California, and Sacaton, Arizona, grown from seeds from San Marcos Island (F.P.I. 92903, 93543, 95656).[4]

This species is unique in having a very small involucel, that disappears long before anthesis. It is most nearly related to *G. harknessii* Brandegee, which differs from *G. armourianum* as follows: Stem or leading branch longer and thicker (attaining a length of 165 cm. and a diameter at base of 6.5 cm.); branches fewer, longer, less intricate, and more nearly erect; twigs

[3] RIDGWAY, ROBERT. *Color standards and color nomenclature.* Washington, 1912, Plate V.

[4] The corresponding C. B. (Cotton Breeding) numbers under which seeds were distributed by the Department of Agriculture are, 862, 867, 930.

less colored, these and the petioles densely stellate-puberulent; stipules longer (3 to 6 mm. long); leaf blades thinner, lighter green, not shiny, at least twice as large, distinctly 3-lobed, usually 7-veined from the base, deeply cordate at base with the sinus usually narrow and often closed above, acutish to short-acuminate at apex; peduncle much shorter (5 to 12 mm. long); involucel more persistent (usually until anthesis), the bractlets much larger (10 to 25 mm. long and 7 to 15 mm. wide), ovate or oblong-ovate, entire, denticulate or often rather deeply few-dentate toward apex; calyx merely undulate or denticulate on the margin and sparsely gland-dotted; capsule broader (often nearly spherical in shape), with inner margins of valves copiously long-ciliate; seeds plumper, the hairs longer, silvery-gray in color.[5]

Another interesting difference is in the oil of the walls of the unripe capsules. This is bright orange in both species, but has merely a peppery odor in *G. harknessii* (as in the cultivated Egyptian cottons), whereas in *G. armourianum* the oil is fragrant, with an odor suggesting that of rose geranium (*Pelargonium graveolens*).

G. armourianum is known only from San Marcos Island, where, as indicated on the labels of Johnston's specimens, it is "very common in draws, on talus and in sandy bottoms." When the writer saw the plants there on April 6, 1931, they were flowering profusely and had many unripe capsules, although there had been no heavy rainfall at that locality for more than 18 months. This species is, therefore, pronouncedly xerophytic like *G. harknessii*, which occurs in similar habitats.

The type collection of *G. harknessii* was made by T. S. Brandegee in 1889 on Santa Margarita Island, off the west coast of Lower California, at approximately latitude 24° 30′ N. This species has been collected also at several localities on the east coast of the peninsula and neighboring islands, from somewhat north to somewhat south of latitude 26°. Plants grown in California from seeds collected on Carmen Island by Collins, Kearney, and Kempton, are very similar to the type specimen in the herbarium of the University of California.

[5] As the two genera are defined by Bentham and Hooker (Genera Plantarum), by Schumann (Engler und Prantl. Natürl. Planzenfam.), and by Ulbrich (in Bot. Jahrb. 50 (Suppl.): 360, 1914), *armourianum* belongs to *Cienfugosia* rather than to *Gossypium*, because of its caducous involucel of small, narrow bractlets. But in *G. harknessii* the bractlets are much larger and less caducous and in *G. davidsonii* Kellogg they are both large and persistent. The three species are so evidently related to one another and are so like *Gossypium* in other characters that reference of any of them to *Cienfugosia* would be an unsatisfactory solution.

ZOOLOGY.—*Descriptions of five new species of seahorses.*[1] ISAAC GINSBURG, U. S. Bureau of Fisheries. (Communicated by WALDO L. SCHMITT.)

An attempt to elaborate satisfactory characters by which to distin-

[1] Published by permission of the U. S. Commissioner of Fisheries. Received August 9, 1933.

guish properly the American species of *Hippocampus* and their close relatives on the eastern Atlantic coast led to the surprising discovery that the following five species have remained unnamed to this late date. In view of the chaotic state in which the taxonomy of *Hippocampus* was found to be during the course of this study, a revisionary account of the species inhabiting these waters has been prepared and will be published at a later date.

Hippocampus europaeus, new species

Description of type specimen: Brood pouch well developed. Trunk segments 11. Caudal segments 39. Dorsal rays 18. Pectoral rays 14. Coronet of medium height, rather broad. Tubercles of medium development, not markedly obtuse. Length 95 mm.; depth 15.8; head 19.7; snout 6.4; eye 4.2; postorbital part of head 10.1; trunk 29.7; and tail 65.2 per cent of length.
Holotype: U.S.N.M. Cat. No. 28544; La Rochelle, France.

Discussion: It seems strange, indeed, that what appears to be a common seahorse on the Atlantic coast of France and possibly other parts of Europe, should prove to be a new species. However, a study of the European material available to me, although not extensive nor in the best of condition, admits no other interpretation. The seahorses from the Atlantic coast of Europe were heretofore identified with either one or the other of the two common Mediterranean species. As compared with those species, it differs from *H. guttulatus* Cuvier in having a markedly shorter snout, there being no intergradation in the material examined, and in having less numerous dorsal and pectoral rays, these latter characters intergrading to some extent. In the short snout it agrees with *H. hippocampus* Linnaeus (most generally designated as *H. brevirostris* by authors), but differs from the latter in having a more slender trunk, better developed tubercles, and, on the average, more numerous caudal segments and dorsal rays, and to a lesser extent also more pectoral rays. In connection with this study, 9 specimens of *europaeus*, 4 of *hippocampus*, and 24 of *guttulatus* have been examined. Study of a larger series might possibly show a greater degree of intergradation and a subspecific status for *europaeus* might be thought desirable, but there is no doubt that it is recognizably distinct from either of the two common Mediterranean species.

Hippocampus reidi, new species

Description of type specimen: The brood pouch well developed, extending to fifth caudal segment. Trunk segments 11. Caudal segments 37. Dorsal rays 17. Pectoral rays 16. Tubercles obsolescent. Coronet markedly low and blunt. Trunk notably slender. Length 121 mm.; depth 15.2; head 22.6; snout 11.2; eye 3.6; postorbital 9.8; trunk 33.4; and tail 62.2 per cent of length. Covered densely with small brown spots against a lighter background; ground color profusely sprinkled with minute, almost microscopic, white dots.

Holotype: U.S.N.M. Cat. No. 86590; St. George, Grenada, British West Indies; W. O'Brien Donovan. I have also studied specimens of this species from Porto Bello, Panama; Jamaica, West Indies; and Port-au-Prince, Haiti.

Discussion: This species is evidently close to *H. punctulatus* and may be distinguished from the latter by its markedly slender trunk, when specimens of like size and the same sex are compared, the comparatively lower coronet, the absence of tubercles on the upper margin of the trunk, and the markedly different color pattern. In its obsolescent tubercles it nearly agrees with *H. hippocampus* from the Mediterranean, differing from the latter in its slender body, longer snout and the pectoral rays being more numerous on the average.

The species is named for Mr. Earl D. Reid, Aid in the Division of Fishes of the U. S. National Museum.

Hippocampus obtusus, new species

Description of type specimen: Brood pouch just beginning to develop, in form of elliptical fold of skin on anterior 4 caudal segments. Trunk segments 11. Caudal segments 35. Dorsal rays 17. Pectoral rays 16. Every third spine on trunk and every third or fourth on anterior part of tail having a peculiar and characteristic form, very stout and very obtuse, reduced to stout stumps. Coronet of medium height. Length 70 mm.; depth 11.8; head 24.5; snout 10.7; eye 4.4; postorbital 10.8; trunk 35.2; and tail 60.9 per cent of length.

Holotype: U.S.N.M. Cat. No. 84527; secured by the *Albatross* from off Cape Hatteras, North Carolina; June 5, 1885.

Discussion: Although this specimen was taken within the geographic range of *hudsonius* and the counts of its meristic characters also fall within the range of variation of that species, it evidently represents a distinct species, separable chiefly by the peculiar structure of the tubercles. The trunk in the present species is conspicuously more slender, even more so than the extreme variants of the specimens of *hudsonius* which have been measured. The specimen described has been compared with over 70 specimens of *hudsonius.*

Hippocampus hildebrandi, new species

Description of type specimen: No rudiment of a brood pouch, probably a female. Trunk segments 11. Caudal segments 39. Dorsal rays 21. Pectoral rays 17. Every third or fourth spine on upper ridge of trunk and anterior part of tail conspicuous as a stout but short and stumpy projection, the appearance very characteristic. Coronet of medium height. Length 68 mm.; depth 13.7; head 24.4; snout 10.2; eye 4.4; postorbital 10.6; trunk 30.1; and tail 65.4 per cent of length. No definite color pattern discernible.

Holotype: U.S.N.M. Cat. No. 82063; Chame Point, Pacific coast of Panama; Robert Tweedlie.

Discussion: This species is the Pacific coast counterpart of *H. obtusus,* differing from the latter in the more numerous dorsal rays and caudal segments.

I take pleasure in naming this species after Dr. Samuel F. Hildebrand, Ichthyologist, of the U. S. Bureau of Fisheries.

Hippocampus regulus, new species

Description of type specimen: A male with the brood pouch fully developed. Length 30.5 mm.; depth of trunk 18.4; head 22.6; snout 6.9; eye 5.9; postorbital part of head 12.1; length of trunk 33.8; and tail 62.3 per cent of length. Dorsal rays 11. Pectoral rays 11. Trunk segments 10. Caudal segments 30. Coronet conspicuously high. Tubercles of medium development. Color dark, faintly shaded with lighter; no definite color pattern.

Holotype: U.S.N.M. Cat. No. 92950; Harbor Island, Texas; May, 1927; J. C. Pearson. Specimens studied also from Cat Island, Miss., Hog Island, Texas; Champoton, Campeche, Mexico (Zoological Museum, University of Michigan).

Discussion: This species differs from *H. zosterae* Jordan and Gilbert chiefly in having fewer dorsal rays and caudal segments, although there is more or less intergradation in these characters.

ZOOLOGY.—*Some Greenland hydroids.*[1] C. McLEAN FRASER, University of British Columbia. (Communicated by WALDO L. SCHMITT.)

The small collection of hydroids obtained by Captain R. A. Bartlett in the course of his expeditions to the coasts of Greenland and Baffin Land, 1925–32, and entrusted to me for report through Dr. Waldo L. Schmitt of the United States National Museum, has proved to be of considerable interest.

There are four lots in the collection. From the east coast of Greenland, some hydroid material was obtained in Clavering Fiord, near Clavering Island (10–35 fathoms), in Lat. 74° 20′ N., Long. 21° W., on August 2, 1930. From west of Greenland, the largest lot was obtained off Cape Alexander at the entrance to Smith Sound, in approximately Lat. 78° 15′ N., Long. 75° W., on August 26, 1932. Another lot was obtained 60 or 70 miles farther south, 5 miles south of Cape Chalon (Prudhoe Land), on July 27, 1932. Finally, a few specimens were obtained from the southern corner of Fox Basin (34–37 fathoms), in Lat. 66° 46′ N., Long. 79° 15′ W., on August 13, 1929. As Fox Basin is separated from the Greenland waters by Baffin Land, these are not strictly Greenland hydroids, but as there were only two species, both of which have been obtained from Greenland waters, they are included here.

[1] Received September 5, 1933.

Twenty-two species in all were obtained, 15 from east of Greenland, 17 from west of Greenland, 10 being common to the two. The ten common species were:

Eudendrium tenellum Allman
Campanularia integra (MacGillivray)
Calycella syringa (Linn.)
Halecium curvicaule v. Lorenz
Halecium muricatum (Ellis and Solander)
Halecium tenellum Hincks
Grammaria abietina (Sars)
Lafoea fruticosa Sars
Lafoea gracillima (Alder)
Sertularella tricuspidata (Alder)

Those found in the eastern collection but not in the western were:—

Garveia groenlandica Levinsen
Eudendrium ramosum (Linn.)
Filellum serpens (Hassell)
Hebella calcarata (Agassiz)
Sertularella tenella (Alder)

Those found in the western collection but not in the eastern were:—

Campanularia groenlandica Levinsen
Campanularia verticillata (Linn.)
Campanularia volubilis (Linn.)
Obelia longissima (Pallas)
Cuspidella grandis Hincks
Halecium labrosum Alder
Thuiaria thuja (Linn.)

The collections are not very different from previous Greenland collections but as they were obtained from locations previously unexplored, the known distribution of the various species is extended.

Of the 15 species from Clavering Fiord, four have not been reported previously from east Greenland. Two of these, *Cuspidella grandis* and *Sertularella tenella*, have been obtained from the Arctic regions both to the eastward and to the westward, hence it is not surprising that they are found here. The other two, *Eudendrium ramosum* and *Hebella calcarata*, have not previously been reported from such high latitude. *E. ramosum* has been reported from the Pacific Coast and the Atlantic coast of North America and from western Europe. This

serves as the first record to connect up the distribution in these three areas as it is connected up in many other species.

With *Hebella calcarata*, the case is somewhat different. It has a wide distribution but in areas apparently little related to those in which the other species are found. The nearest recorded locality is off Nova Scotia. From this as a farthest north, it is distributed along the Atlantic coast of North America, south to Florida, on the west coast of Africa, different areas in the Indian ocean, off Japan, Australia and New Zealand, all in comparatively low latitudes.

From the west coast, all of the species but one (*Thuiaria thuja*), listed, were found off Cape Alexander. These have all been reported from the west coast of Greenland, but I believe they have never before been reported from so far north. It is quite possible that hydroids have not been obtained so far north previously in any region. As the colonies of hydroids were just as luxuriant as those growing elsewhere, frigidity does not seem to be a factor detrimental to growth.

The locality near Cape Chalon is not far enough away from Cape Alexander to expect a difference in fauna. Six species were obtained; *Campanularia groenlandica*, *Halecium curvicaule*, *H. muricatum*, *Grammaria abietina*, *Lafoea gracillima* and *Sertularella tricuspidata*.

TABLE 1.—DISTRIBUTION OF HYDROIDS

Species	PNA	WArct	ANA	WG	EG	EArct	WE
Garveia groenlandica	0	0	0	0	0	0	—
Eudendrium ramosum	0	—	0	—	0	—	0
Eudendrium tenellum	0	0	0	0	0	0	0
Campanularia groenlandica	0	—	0	0	0	0	0
Campanularia integra	0	0	0	0	0	0	0
Campanularia verticillata	0	0	0	0	0	0	0
Campanularia volubilis	0	0	0	0	0	0	0
Obelia longissima	0	0	0	0	0	0	0
Calycella syringa	0	0	0	0	0	0	0
Cuspidella grandis	0	0	0	0	—	0	0
Halecium curvicaule	—	—	0	0	0	0	0
Halecium labrosum	0	0	0	0	0	0	0
Halecium muricatum	0	0	0	0	0	0	0
Halecium tenellum	0	0	0	0	0	0	0
Hebella calcarata	—	—	0	—	0	—	—
Filellum serpens	0	0	0	0	0	0	0
Grammaria abietina	0	—	0	0	0	0	0
Lafoea fruticosa	0	0	0	0	0	0	0
Lafoea gracillima	0	0	0	0	0	0	0
Sertularella tenella	0	—	0	0	0	0	0
Sertularella tricuspidata	0	0	0	0	0	0	0
Thuiaria thuja	0	—	0	0	0	0	0

From Fox Basin there were but two species, *Campanularia volubilis* and *Thuiaria thuja*.

It is of interest to note that even in a small collection like this there is such definite evidence that most of the species reported from the higher latitudes in the northern hemisphere have had their origin in the polar area, from which area they have been distributed throughout the circumpolar regions and then south along the coasts of the continents.

Of the 22 species listed, all but two have been reported from the Pacific Coast of North America, all but seven, from the Arctic regions west of the area under consideration, all of them from the Atlantic coast of North America, all but two from the Arctic regions to the eastward, and all but two from western Europe. The larger number unreported from the western Arctic is probably due to the small amount of collecting rather than to the actual absence of the species.

The accompanying table illustrates the distribution of the 22 species. PNA indicates the Pacific coast of North America; WArct, the Arctic regions to the westward; ANA, the Atlantic coast of North America; WG, the west coast of Greenland; EG, the east coast of Greenland; EArct, Arctic regions to the eastward; WE, West coast of Europe. A cipher indicates the presence of a species within the area indicated.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

253RD MEETING

The 253rd meeting of the Academy was an informal reception at the Bureau of Standards on March 23, 1933. About 250 persons viewed *An exhibit of certain phases of scientific work in Washington* and were informally received by Director LYMAN J. BRIGGS and President R. F. GRIGGS of the Academy.

254TH MEETING

The 254th meeting of the Academy was a joint meeting with the Medical Society of the District of Columbia, held in the Assembly Hall of the Cosmos Club on Thursday, April 20, 1933. About 100 persons were present. President ROBERT F. GRIGGS called the meeting to order and turned over the chair to Doctor FOWLER, President of the Medical Society, who introduced Doctor HENRY E. SIGERIST of Johns Hopkins University. Doctor Sigerist delivered an illustrated address on *Medicine of the Renaissance*.

CHARLES THOM, *Recording Secretary*.

RECENTLY ELECTED TO MEMBERSHIP IN THE ACADEMY

CLARIBEL RUTH BARNETT, librarian, U. S. Department of Agriculture Library, was elected to membership in recognition of her long experience in cataloging and classifying scientific literature, in managing scientific libraries and in carrying on scientific bibliographic research.

NELLIE A. BROWN, associate pathologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, was elected to membership in recognition of her work on the bacterial diseases of plants.

SAMUEL B. DETWILER, principal pathologist in charge, Division of Blister Rust Control, Bureau of Plant Industry, was elected to membership in recognition of his work on forest tree diseases and their control.

HORACE S. ISBELL, chemist, Bureau of Standards, was elected to membership in recognition of his contributions to the chemistry of carbohydrates.

WILLIAM M. MANN, director, National Zoological Park, Smithsonian Institution, was elected to membership in recognition of his contributions to entomology and to the maintenance and development of zoological parks.

ROBERT D. RANDS, senior pathologist, Division of Sugar Plant Investigations, Bureau of Plant Industry, was elected to membership in recognition of his contributions to plant pathology and in particular for his researches on the diseases of rubber, cinnamon, and sugar cane.

HARRY W. SCHOENING, chief, Pathological Division, Bureau of Animal Industry, was elected to membership in recognition of his researches in the field of veterinary pathology.

JAMES S. SIMMONS, director of laboratories, Army Medical Center, was elected to membership in recognition of his contributions to medical bacteriology.

ROBERT E. SNODGRASS, senior entomologist, Division of Insect Morphology, Bureau of Entomology, was elected to membership in recognition of his contributions on insect anatomy.

LOUISE STANLEY, chief, Bureau of Home Economics, was elected to membership in recognition of her investigations on the problems of home economics and food chemistry.

LANSING S. WELLS, associate chemist, Bureau of Standards, was elected to membership in recognition of his studies on the heterogeneous equilibria between aqueous and metallic solutions and the hydration of Portland cement.

GEOLOGICAL SOCIETY

501ST MEETING

The 501st meeting was held at the Cosmos Club, March 8, 1933, President C. N. FENNER presiding.

Informal communications.—DAVID WHITE exhibited specimens of layered grits of Lower Pennsylvanian age from Orange and Perrin counties, Indiana. Lighter colored layers, about $\frac{1}{4}$ inch thick, which are used in the manufacture of whetstones, are separated by thinner zones in which there are two dark bands richer in carbonates and organic matter. The dark bands, correlated by Dr. White with times of slack sedimentation, are believed by him

to reflect a seasonal hot dry climate, since xerophytic plant fossils are found associated with them.

FRANK L. HESS exhibited carbonate oolites about the size of small peas from a well 3,125 feet deep in Union County, Arkansas. Almost all the oolites have at least one "dimple" on the outer surface and some have four or five. He suggested that the oolites were probably formed in the churning water of the well.

Program: PARKER D. TRASK and HARALD E. HAMMAR: *Some relations of the organic constituents of sediments to the formation of petroleum.*—This paper is a preliminary report of the results of the first 18 months investigation of source beds of petroleum conducted by the United States Geological Survey and the American Petroleum Institute. Most of the work has dealt with methods of investigation, but several tentative inferences have been reached.

In the Santa Fe Springs oil field in California the ratio of oil production to organic content of the sediments (after preliminary extraction with CCl_4) appears to be fairly constant throughout the eight producing zones in the field. It would seem more likely therefore that the oil in any individual zone was generated largely from the sediments in that zone rather than from sediments in some other zone—that is, the sands and silts contiguous to the oil actually are source beds. As the sediments in the oil zones consist largely of fine-grained sands, it would seem that under certain conditions oil may be generated from sands. The organic content of sediments is consistently small throughout the entire 4,000 feet of producing beds and is of the order of magnitude of 1.5 per cent. This small quantity of organic matter suggests that some low grade sediments are satisfactory source beds of oil and that mere richness in organic content is not necessarily a characteristic of source beds.

The volatility of the organic content of the sediments in general increases from the uppermost producing zone to the lowermost producing zone—that is, the organic constituents of the deepest and oldest beds contain much more volatile matter than do those of younger beds 4,000 feet above.

The available data indicate that the nitrogen content of the organic matter in general decreases with the age of the rocks. Carboniferous sediments contain about one half as much nitrogen with respect to the organic content, and Pliocene sediments about two-thirds as much, as do recent sediments. That is, two-thirds of the nitrogen that disappears is lost in one-tenth the time. This indicates that the nitrogen compounds are altered to a much larger extent shortly after their deposition than they are after they have been buried for a long time. This phenomenon suggests, therefore, that the period of time immediately following the deposition of sediments is of major importance in the generation of petroleum. However, as the nitrogen compounds continue to change even after a long interval, as indicated by the significant loss in nitrogen between Pliocene and Carboniferous, it seems that it could be possible to have more than one period of petroleum generation. (*Authors' abstract.*)

Discussed by Messers. D. WHITE and MONROE and Miss T. STADNICHENKO.

ELEANORA B. KNOPF.—*New methods for attacking the problems of metamorphism.*

Discussed by Messrs. GILLULY, GOLDMAN, KING, C. P. ROSS, BOWEN, and MERTIE.

502ND MEETING

The 502nd meeting was held at the Cosmos Club, March 22, 1933, President C. N. FENNER presiding.

Informal communications.—J. C. REED showed lantern slides of a large spring, 50 feet in diameter, at the foot of Muldrow glacier on the north side of the Alaska Range. The spring feeds the headwaters of McKinley Fork of Kantishne River, and continues to flow at temperatures well below freezing, for during cold weather an ice wall about 6 feet high builds up around the spring. Mr. Reed suggested that the spring marks the emergence of a subglacial stream from a portion of the glacier concealed by the river gravels.

Program: JAMES GILLULY: *Internal evidence of the origin of certain schists.* —The important results of recent studies of metamorphic rocks, especially by Sander and Schmidt in Austria, include the discovery that the systematic anisotropy of the rock fabric is commonly correlatable with the tectonic movements which the rock has undergone. Most of their work has been on the dynamometamorphosed east Alpine rocks and such a correlation is perhaps not unexpected. It appeared worth while to apply the methods of Schmidt to the problem of the conditions of metamorphism of rocks whose characters are commonly attributed to static or load metamorphism.

Professor Daly, whose report on the Shuswap terrane of interior British Columbia contains a clear description of supposedly load-metamorphosed rocks, very kindly sent me specimens and thin sections for study.

If the metamorphism of the Shuswap rocks were purely static one would anticipate that the contained minerals would have an arrangement symmetrical with respect to the normal to the schistosity. A statistical study of the orientation of the quartz and biotite of two specimens of the rocks showed, however, a decided arrangement in a girdle, not oriented parallel to the schistosity, but normal to the schistosity. This is the arrangement found in many dynamometamorphosed rocks and seems to indicate that, whatever the cause of the metamorphism, the orientation of the minerals as now seen is a result of systematic differential movement between the component grains. The planes of schistosity have acted as shear planes. In the laboratory it is of course impossible to determine whether or not these differential movements correlate and integrate to large scale deformation, but it appears that the orientation pattern in the Shuswap rocks is precisely analogous to that found in the Alpine tectonites. It can safely be said that whether or not the metamorphism of the Shuswap rocks is due to load it was surely not static. The present rock fabric bears unmistakable evidence of kinetic effects.

In view of these features, the possibility that the Shuswap rocks were metamorphosed during flat overthrusting like that of the Alps must be given consideration, though naturally this possibility must be investigated in the field. It is not yet clear that a distinction can be made between yielding under load and consequent lateral flow on the one hand, and tangential movement of great masses on the other. (*Author's abstract.*)

Discussed by Messrs. STOSE, HESS, BUTTS, PARKER, RUBEY, FENNER, and Miss JONAS.

C. WYTHE COOKE: *Origin of the so-called meteorite scars of South Carolina.* —In the Journal of Geology, **41**: 52–66, 1933, F. A. Melton and William Schriever describe certain low elliptical sand ridges near Myrtle Beach, S.C.,

that are conspicuous in aerial photographs and suggest that they may surround scars made by meteorites. The ridges are remarkable for their symmetry in plan and for the fact that the major axes of all the ellipses are parallel to one another and extend at right angles to the seashore.

Study of the photographs reveals many details of form that are characteristic of the work of waves and currents on unconsolidated sand. All the elliptical ridges border or lie within ancient waterways that were active during the late Pamlico epoch of the Pleistocene, when sea level stood 25 feet higher than now. The ridges appear to be beaches and sand bars built by wind-driven currents and waves before the waterways became clogged by vegetation. The ellipses are oriented alike probably because the winds that propelled the waves and currents that shaped them blew from the ocean. (*Author's abstract.*)

Discussed by Messrs. W. C. MANSFIELD, D. WHITE, THOMPSON, RUBEY, BRIDGE, and HENDRICKS.

DAVID WHITE: *Pre-Cambrian seas?*—Recalling that limestones, calcareous shales, and black shales, such as are in general regarded as characteristic of marine deposits, are extensively found in all areas of not too altered Algonkian, and emphasizing especially the prevalence of thick limestone formations in the Proterozoic—e.g., 50,000 feet (see Adams and Barlow) in the Grenville of Ontario, about 5,000 feet in the Canadian Northwest, 7,500 feet in the Belt region, over 1,200 feet in northern Arizona, 2,500 feet more or less in Siberia, 6,000 feet in China, and considerable thicknesses in India, Australia, and South Africa—the speaker insisted that the burden of proof that the known pre-Cambrian is entirely of fresh water origin rests with the geologists who still hold to that view.

The conclusion, based on lack of faunas identified as marine, that all pre-Cambrian basins of marine deposition foundered without trace before Cambrian time, never to reappear, postulates not only a sudden post-Algonkian departure in geotectonics, but also a reversal of geologic processes. Otherwise, where are the great fresh water limestone formations and heavy non-marine calcareous shale series of the Cambrian, Ordovician, and Silurian? Ripple marks, suncracks, and salt hoppers are very common in the Algonkian, but they are not peculiar to it.

Failure to discover marine animals approaching the Cambrian in form and diversity in association with the Algonkian deposits of carbonaceous matter, sedimentary iron, algal limestone, and some remains identified as animal, finds explanation in uranium lead ratios, which indicate ages of 780 million years for the late Huronian, and 1060 million years for earlier Huronian, possibly, but less than 475 millions—less than one-half as much—for early Cambrian. The life remains found in the recognized late pre-Cambrian series are representative of the sea life of the time. This life has its own characteristics and already promises bases for very rough paleontological correlations, as is shown by the presence of distinctive American forms of algal deposits in the Canadian Northwest, Siberia, China, and Australia. The great blossoming out of pre-Cambrian animal life was later than the Huronian and probably much later than the Belt series, which, but for the compensation of tremendous horizontal stresses by the Lewis and other overthrusts of the region, might well have been as far altered as the Huronian of the Lake district and possibly as the Grenville of the Adirondack and Laurentian regions. The records of most brilliant life evolution before the Cambrian should be found in rocks dated within the 200 million years pre-

ceding the earliest Cambrian, or more than 100 million years later than the Huronian or possibly the Animikie. (*Author's abstract.*)

Discussed by Messrs. RESSER and HEWETT.

503RD MEETING

The 503rd meeting was held at the Cosmos Club April 12, 1933, President C. N. FENNER presiding.

Informal communication.—ROBERT KING described an area of Permian rocks in Mexico, several hundred miles south of the nearest outcrops in Texas. This area of 171 square kilometers is on a pediment on each side of a plateau between the two branches of the Sierra Madre, which are composed of folded Cretaceous rocks. The Permian section has a maximum thickness of 11,000 feet, but much of this thickness is due to the inclusion of surface volcanic rocks. The beds represented include both the highest and lowest portions of the Permian as known in North America. They are folded into a syncline, and are cut by thrust faults. Nearby flat Cretaceous beds overlie the Permian beds unconformably. Thus the relations here differ notably from those the Trans-Pecos Texas region, where the major deformation is pre-Permian.

Discussed by Mr. J. S. WILLIAMS.

Program: P. J. SHENON and J. C. REED: *The relationship of the quartz veins to the regional structure in the Elk City district, Idaho.*—The gold-bearing quartz veins of the Elk City district of north-central Idaho stand nearly at right angles to a linear elongation of minerals in the country rocks. This linear element is to be distinguished from the more commonly recognized schistosity or planar foliation of gneissic and schistose rocks.

Banded gneiss is the most abundant rock in the district. It is interbedded with schist and quartzite and in some places these rocks have been intruded by sills and dikes. Irregular bodies of augen gneiss lie transverse to the trend of the banded gneiss and schist. Granodiorite crops out over a large area and extends beyond the limits of the district. Most of the veins lie within two miles of the gradational contact between the granodiorite and the older gneiss and schist.

The right-angle relationship between the veins and the mineral elongation appears to be genetic because the measured orientations of the veins do not differ from a position at right angles to the elongation by more than might be expected considering the errors inherent in the data used. Furthermore, the departures from a 90 degree relationship appear to be systematic as most of the veins dip somewhat more steeply than they would if they were exactly normal to the mineral elongation.

Hans Cloos and others have shown that a right-angle relationship exists between a linear element, called "stretching," and a set of "Q" or cross joints in certain igneous rock masses. The same phenomenon has also been observed in metamorphic rocks. According to Cloos and his associates the "stretching" is a result of mineral orientation during flow, and the "Q" joints develop at a slightly later stage by tension at right angles to the "stretching." In this paper the relationship between the veins and the mineral elongation is compared to that between the "stretching" and the "Q" joints, but statements concerning the origin of the fractures containing the veins are avoided because a much greater areal study will be necessary before adequate data for positive conclusions can be gathered, and also be-

cause the writers are not convinced that they necessarily form in the manner postulated by Cloos.

An understanding of the relationship between the veins and the elongation will be of economic importance as a guide to prospecting and as a factor in forming a conception of the probable extent and attitude of veins and ore bodies both horizontally and in depth. (*Authors' abstract.*)

Discussed by Messrs. GILLULY, TRASK, and JOHNSTON.

FRANÇOIS E. MATTHES: *The Pleistocene diversion of the Mississippi River across Crowleys Ridge, southeastern Missouri.*—A short distance below Cape Girardeau, Mo., the Mississippi River abruptly leaves the broad cliff-lined trench which it has carved across the limestone uplands of Missouri and Illinois, and, turning south-southeastward, cuts across Crowleys Ridge in a narrow rock floored gorge. It then debouches upon the broad lowland to the southeast of the ridge which originally was the path of the Ohio, and meets that river at Cairo. There is abundant evidence showing that before this remarkable diversion took place the Mississippi continued along the west side of Crowleys Ridge, and met the Ohio at some point below the site of Helena, Ark., fully 200 miles below the present point of confluence.

The only hypothesis to account for the Mississippi's diversion across Crowleys Ridge has been offered by C. F. Marbut and is to the effect that the river was captured by a south-southeastward flowing streamlet on the broad surface of the ridge that was tributary to the Ohio. During the Pleistocene epoch, when it flowed immediately along the southeast side of Crowleys Ridge, the Ohio presumably lay at a somewhat lower level than the Mississippi, and owing to this circumstance and the fact that the southeastern margin of Crowleys Ridge is composed of weak unconsolidated sediments of Tertiary age, whereas the northwestern margin is composed of hard Paleozoic rocks, the hypothetical south-southeastward flowing streamlet had a double advantage over the northwestward flowing streamlets tributary to the Mississippi, and was able to capture one of these as it eroded headward. A low gap was thus formed in the ridge, and through this gap eventually the waters of the Mississippi found their way when the bed of the river was raised by aggradation to a sufficiently high level.

Marbut went further and supposed the Mississippi to have been diverted by this process of indirect capture three times in succession at different points in southeastern Missouri—first through the gap in Crowleys Ridge now traversed by Castor River, then through the gap now traversed by Little River, and finally through the gorge now occupied by the Mississippi. However, the drainage pattern on this portion of Crowleys Ridge affords no indications whatever of rapidly headward growing streamlets tributary to the Ohio, either at the gaps mentioned or elsewhere. On the contrary, it shows only northwestward draining streamlets whose maturely developed ramifications were never disturbed by pirate streams. Moreover, the southeastern margin of Crowleys Ridge is indented only by short ravines, and it is apparent that there has not been sufficient time for the headward growth of pirate streams 8 or 9 miles in length, nearly across the width of the ridge, as is demanded by Marbut's theory. That theory, therefore, does not appear well founded.

Recent investigations in southeastern Missouri have revealed the presence of numerous terrace-like remnants of ancient flood plains of the Mississippi in protected recesses on the sides of the different gaps in Crowleys Ridge, likewise in the abandoned valley of the Mississippi between the ridge and

the Ozark Highland, and along the sides of the Mississippi trench at and above Cape Girardeau. These terraces are composed of stratified silts and sands containing a large proportion of granitic and other crystalline material of northern origin. The highest and oldest, which stand 50 to 60 feet above the present flood plain of the Mississippi, are in part covered by loess. There can be no doubt that they are remnants of a filling of glacial outwash derived from the later ice sheets that lay to the north of the area.

The topographic relations of the upper terraces are such as to indicate that at the time of maximum aggradation the waters of the greatly swollen Mississippi spilled simultaneously through a number of shallow gaps in the sky line of Crowleys Ridge. These gaps or spillways consisted of originally northwestward draining valleys that had been beheaded by the progressive paring away of the southeastern margin of the ridge by the Ohio River.

After the period of maximum aggradation the river cut down the main spillways to successively lower levels. The old Mississippi valley along the northwest side of Crowleys Ridge, however, remained obstructed by sediment, and so when the waters contracted in volume they abandoned that valley. At a later stage they abandoned the broad gap through which Little River now finds its way, and they remained confined to the narrow gorge which the river still occupies. That gorge presumably afforded the most direct and steepest channel to the Ohio, and its narrowness doubtless helped to maintain a concentrated current and to prevent deposition.

Discussed by Messrs. ALDEN, HENBEST, SEARS, STEPHENSON, THOMPSON, and FENNER.

504TH MEETING

The 504th meeting was held at the Cosmos Club April 26, 1933, President C. N. FENNER presiding.

Program: W. T. SCHALLER: *Correlative mineralogy of the potash mine, New Mexico.*

Discussed by Mr. LANG.

VINCENT P. GIANELLA and EUGENE CALLAGHAN: *The Cedar Mountain, Nevada, earthquake of December 20, 1932.*—An earthquake of major intensity originated in the area east of the Gabbs Valley Range and Pilot Mountains, near Mina, southwest of the center of Nevada on December 20, 1932, at about 10:04 P.M. P.S.T. It was definitely perceptible over an area of about 400,000 square miles including Nevada and parts of California, Oregon, Idaho, Utah, and Arizona. A circle including the scattered outermost points from which reports were received would have an area of nearly 1,000,000 square miles. It is remarkable, however, that no lives were lost and damage was confined to the demolition of one stone cabin and an adobe cabin, damage to ore-treating plants and mines, broken chinaware and crockery, and minor items. Several factors may be held to account for this, including the sparse population (there were scarcely a dozen people in the epicentral area), location of nearly all structures on rock, lack of water-soaked alluvial fill, and probable great depth of the point of origin. There were a number of the effects noted as usual in earthquake areas, such as the change in flow of springs, avalanches of boulders down steep slopes, churning of surface soil in places and upthrown boulders in at least one place. Aftershocks are to be numbered in the thousands and were reported as still continuing on April 23, though at greatly reduced frequency and intensity.

The main shock of the earthquake accompanied the formation of a series of tension faults or rifts over an area 38 miles in length and 4 to 9 miles in

width in the lowland between the Gabbs Valley Range and Pilot Mountains on the west and Paradise Range and Cedar Mountain on the east. The lowland is an area of partly dissected pediment slopes with a thin alluvial mantle on Tertiary lake beds and volcanic rocks, whereas the mountain ranges consist largely of pre-Tertiary rocks. In many places the rifts follow breaks in slope and the margins of low hills, indicating that they are related to earlier faults. Sixty rifts in various parts of the area were observed and undoubtedly many escaped detection because of the heavy snowfall that terminated the investigation. The rifts form an en echelon pattern, as most of them have an average trend of N. 11° E., whereas the direction of the rift area is N. 21° W.

Individual rifts are from a few hundred feet to nearly four miles in length, and consist of zones of fissures that range from a few feet to several hundred feet in length. Individual fissures generally trend more to the northeast than the direction of the rift, except in those places where the rifts trend more to the east than N. 35° E. This gives them an en echelon pattern within the rifts. Vertical displacement may be either to the east or the west and the throw is generally less than a foot. Horizontal movement is indicated by compression ridges on fissures at a sharp angle to the direction of some of the rifts and by actual horizontal displacement of as much as 34 inches. Grabens are common features of most of the rifts and may be as much as 100 feet wide, with a wall four feet high on one side and two feet high on the other. Most of them are less than 15 feet in width with a displacement of less than a foot.

The en echelon pattern of the rifts and the remarkable uniformity of en echelon pattern of fissures within the rifts together with evidence of actual horizontal movement with the east side toward the south, indicate that the rifts were caused by a definite directional stress. This can be explained as the result of a southward shift of the Paradise Range and Cedar Mountain block on the east in reference to the Gabbs Valley Range-Pilot Mountains block on the west. It resembles the movement on the San Andreas rift, except that its movement was distributed over a zone several miles wide rather than a few hundred feet. A possibility of origin due to differential uplift causing torsional stress may be entertained but is not readily demonstrable. (*Authors' abstract.*)

Discussed by Messrs. SEARS, FERGUSON, and KING.

A. F. FOERSTE: *The migration of certain Paleozoic arctic faunas.*

Discussed by Mr. RESSER.

505TH MEETING

The 505th meeting was held at the Cosmos Club May 10, 1933, President C. N. FENNER presiding.

Informal communications.—A. R. BARWICK of Catholic University exhibited some specimens of Triassic shale of the Newark formation from Virginia which showed calcareous structures which he suggested might be fossil Ostreidae. A part of the Newark deposits therefore, may possibly be of marine origin.

F. E. MATTHES presented a brief note on the discovery of what is known as the Stadter Buried Forest on Mount Hood, Oregon—a tangled mass of tree trunks protruding from beneath a moraine of the Zigzag Glacier. This overridden forest, though situated near the level of the present timber line, was composed of tall, straight trees, including species that now occur 1,000

to 2,000 feet lower down. The number of annual rings per inch, moreover, is characteristic of tree growth at the lower levels. The buried forest, therefore, appears to indicate that prior to the ice advance there was a prolonged period of climatic conditions milder than those that prevail at the present time. Corroborative evidence is found in the northern part of the Cascade Range. It seems entirely probable, in view of the great altitude at which these remnants of ancient rain forests occur, that during the mild period postulated the Cascade Range bore no glaciers, save possibly a few on its highest peaks. It follows that nearly all of its present glaciers, and probably all those on the Sierra Nevada and the Rocky Mountains, have come into existence during relatively recent times and are not to be regarded as remnants of the great glaciers of the Pleistocene epoch.

Discussed by Messrs. HESS and BUTTS.

Program: J. P. MARBLE: *Some recent developments in the Pb/U method for age determinations.* The importance of fresh, unaltered, primary material for analysis was stressed, also the need for thorough geologic and petrographic studies on minerals and rocks. Wherever possible the atomic weight of lead in the mineral as analyzed should be determined. Recent work shows the existence of pure uranium lead in minerals. The value and applications of magneto-optic method of study and the reliability of some recent determinations were discussed, and the need for new data along several lines pointed out. Preliminary analyses on a pitchblende from Great Bear Lake, N.W.T., Canada, giving a Pb/U ratio of 0.201, and apparent "corrected" age of about 1375 million years, were discussed on the above basis. Final figures await further study, and the receipt of more satisfactory material. (*Author's abstract.*)

Discussed by Messrs. HESS, and R. C. WELLS.

M. N. BRAMLETTE: *Rhythmic bedding in the Monterey rocks of California.*—A conspicuous rhythmic bedding occurs in these rocks in which the beds are generally between one and two inches thick, and each shows a distinct sequence of deposition with sand at the base, grading upward through finer clastic material to an upper zone of organic deposition—largely diatoms. The various processes that might produce such bedding have been considered and the tentative conclusion reached that annual cycles best fit the evidence, that is, that these layers are marine varves.

Whatever the period of this rhythmic bedding, some significant conclusions may be drawn from the fact that, in order to have been preserved, it indicates deposition below effective wave action. Such conditions result in various distinctive features as contrasted with the more usual sedimentary deposition above wave base. Accumulation of organic matter would be favored, and it is suggested that such rhythmic bedding or the analogous fine lamination in sedimentary formations may be as significant as is fine grain size, in indicating good source beds of petroleum. (*Author's abstract.*)

TEIICHI KOBAYASHI: *A sketch of Korean geology.*—Three phases of the geology of Korea were emphasized; (1) Generally speaking, Manchuria, Chosen and China, together with Indochina and India, comprise one paleographical province in the Cambrian, while in the Ordovician the area was divided into two distinct provinces by the Tsin-ling-Keijo line. The faunas in the Tsinan Basin which covers north China, South Manchuria and north Chosen are closely allied to those of the Arctic and American regions, whereas some of the southern faunas, occurring in south Chosen, central

and south China, Indochina, and Burma, bear an unmistakable relationship to European faunas. (2) During the Jurassic, probably in the middle of the period, a considerable crustal movement occurred in the Korean peninsula. Pressure from the north made the configuration of the fundamental geologic structure, notably the Liaotung direction in the Heinan trough and the Sinian direction in the Yokusen trough; this was followed by tremendous igneous activity in the Cretaceous. (3) In the Cenozoic elevation of the peninsula and depression of the Japan Sea occurred repeatedly—both movements attaining their maximum near the Korean coast. Further, the Cenozoic movements on the whole resulted in the construction of an asymmetrical geanticline on the peninsula and a similar geosyncline in the Sea of Japan. Of the repeated movements the most important is the Miocene revolution which was responsible for the upheaval of the Kaima plateau and the back bone range of the peninsula. (*Author's abstract.*)

Discussed by Mr. FOERSTE.

W. H. BRADLEY and T. B. NOLAN, *Secretaries.*

SCIENTIFIC NOTES AND NEWS

Prepared by Science Service

NOTES

U. S. Public Health Service.—The Public Health Service is investigating the outbreak of amebic dysentery which started in Chicago hotels and restaurants during the Century of Progress exposition, and which has thus far resulted in over fifteen deaths.

An antidote for mercuric bichloride has been discovered by Dr. S. M. ROSENTHAL of the U. S. National Institute of Health. It has already been used successfully to treat a victim of bichloride poisoning. The antidote is still admittedly in the experimental stage. However, results with animals poisoned by bichloride have been very good and the successful result with the first human case is considered encouraging. The new antidote, said to be the first known for mercuric bichloride is formaldehyde sulfoxylate. It is administered simultaneously by mouth and by intravenous injection. Bichloride poisoning is not very common, so that it may be some time before physicians have enough experience with the new remedy to determine its value. Dr. ROSENTHAL has asked Washington hospitals to notify him of any cases so that he may assist them in using the new antidote if they wish it.

Wellcome Prize and medal.—The Wellcome Prize, consisting of $500 and a gold medal, was for 1933 awarded to Major EDGAR ERSKINE HUME, Medical Corps, U. S. Army, Librarian of the Army Medical Library, for his essay, *The value of studies in health and sanitation in war planning.* The Wellcome Prize was established in 1916 by Sir HENRY S. WELLCOME of London, and is awarded annually by a board of judges appointed by the Association of Military Surgeons. Honorable Mention, which includes life membership in the Association, was awarded Lieutenant-Colonel PAUL W. GIBSON of the Army War College.

Pan American Medical Association.—The Washington Chapter of the Pan American Medical Association held its first meeting of the winter season on November 10 at the Peruvian Embassy. The session was devoted to the

memory of the noted Latin-American physician-statesman HIPOLITO UNANUE (1755–1833), recalling his many contributions to science, meteorology, medicine, education, literature, and last but not least national progress. Drs. J. G. LEWIS, E. GIL BORGES, PRENTISS WILLSON, J. G. TRIBLE, T. CAJIGAS and A. A. MOLL spoke. The Peruvian Ambassador, Dr. MANUELD DE FREYRE Y SANTANDER, recalled in a masterly address the many-sided career of Unanue, concluding "What medicine may have lost through his manysidedness Peru gained." The next meeting of the Chapter on December 3 will be devoted to Finlay (1833–1915), the discoverer of the transmission of yellow fever by the mosquito.

A paper by Dr. A. A. MOLL, of the Pan American Sanitary Bureau, on the career of Finlay has been published in the Bulletin of the Pan-American Union for December.

Bureau of Biological Survey.—The Bureau of Biological Survey has begun a special study of wild-fowl baiting, to be carried on throughout the present open seasons along with an investigation of the natural food supplies and the numbers of waterfowl and shorebirds. Twelve members of the Bureau's staff are observing conditions in practically all the principal areas on which wild fowl are shot in the United States, and Federal game protectors throughout the country are making observations supplementing the work of the special investigators. The following members of the Bureau's Washington staff are engaged in this work in the areas named: CLARENCE COTTAM, coastal waters from Maine to the Potomac River; NEIL HOTCHKISS, coastal waters from Virginia to Florida; F. M. UHLER, Illinois River Valley, Missouri, Arkansas, western Kentucky, Tennessee, and northern Mississippi; A. C. MARTIN, coastal Alabama, Mississippi, Louisiana, and Texas; and F. C. LINCOLN, Michigan, Ohio and western Pennsylvania and New York.

Department of Terrestrial Magnetism.—Dr. J. A. FLEMING returned to the Department of Terrestrial Magnetism on October 26, after having attended the very successful meetings of the International Union of Geodesy and Geophysics at Lisbon, Portugal, where he was reelected President of the Association of Terrestrial Magnetism and Electricity of that Union for the period 1933–1936. While in Europe he visited laboratories in France, Switzerland, and Germany in connection with the work of the Department.

Mr. P. G. LEDIG, upon the completion of his magnetic and cosmic-ray work in South America, reported at the Department on September 28.

Lieut. J. C. WOELFEL, U. S. N., of the Hydrographic Office, Navy Department, is spending a few days at the Department receiving instruction in the operation of magnetic instruments preparatory to his departure for Central America where a series of magnetic observations will be made.

George Washington University School of Medicine.—The October lecture in the Smith-Reed-Russell series at the School of Medicine, George Washington University was delivered by Prof. W. W. CORT, School of Hygiene and Public Health, Johns Hopkins University who spoke on *Recent developments in our knowledge of hook-worm disease.* The November lecture of this series will be given by Prof. JAMES W. JOBLING, College of Physicians and Surgeons, Columbia University. At the annual banquet of the Society which was held at the University Club on October 20 an address was delivered by Dr. WILLIAM CHARLES WHITE, Chairman of the Committee on Research of the National Tuberculosis Association. On this occasion new faculty and student members were inducted into the Society.

News Briefs

The famous Treasure of Monte Alban, in Mexico, was shown at the Pan American Union from October 30 to November 4, under the auspices of the Carnegie Institution of Washington and George Washington University. Dr. Daniel de la Borbolla, anthropologist of the Mexican National Museum, gave addresses on the Treasure and its significance at the Union and at George Washington University.

A "Rosetta stone" of ancient American culture has been brought back to the National Museum by Frank M. Setzler. It is an Indian vase found in a mound at Marksville, La., bearing decorations in the well-known Hopewell style on one side, and on the other, marks of a hitherto unknown Indian art style.

The Association of Official Agricultural Chemists met in Washington during the week of November 6.

A method of rapid determination of lead in low concentrations, stated to be extraordinarily delicate and accurate, has been worked out by chemists of the Food and Drug Administration. It has been described by H. J. Wichmann. It depends on the red color reaction when a lead-containing solution treated with ammoniated cyanide is added to a green solution of diphenyl-thio-carbazone ("dithizone") containing chloroform.

An improvement in radio beacons, permitting the simultaneous sending of four distinct signals in four different directions, has been announced by F. W. Dunmore of the National Bureau of Standards.

The Hydrographic Office of the Navy Department was represented at the Fifth Assembly of the International Union of Geodesy and Geophysics at Lisbon, September 17 to 24, 1933, by Captain David McD. LeBreton, U.S. Navy, who presented a paper on *The bathymetry and water circulation of the North Pacific Ocean, and gravity investigations of the West Indies regions.*

The Office was represented at the Fifth Pacific Science Congress June 1–9, 1933, at Victoria and Vancouver, by A. B. McManus, who presented papers on *Recent soundings, gravity investigations, and mapping sea floors,* and *Water circulation in Pacific regions.*

During the year 1933, the U.S.S. *Hannibal,* as opportunity offered during its surveying season in Central American waters, occupied a total of 144 stations. Of these 7 were in the Atlantic and Caribbean, chiefly for training of the sounding crews, 85 in a network covering the Gulf of Panama, and 52 in the littoral waters of Panama and Costa Rica.

The U.S.S. *Gannet* occupied 42 stations in the Aleutian Islands, making temperature observations and obtaining 455 water samples.

The Brookings Institution was addressed on the evening of November 10 by Dr. John Dickinson, Assistant Secretary of Commerce, on *Fundamentals of the recovery program.* On November 14, Henry I. Harriman, president of the Chamber of Commerce of the United States, spoke on *Business and the recovery program.*

A conference of state, federal and private foresters and others interested in forestry subjects was held in the auditorium of the Department of the Interior on October 26. In connection with this meeting, the Department of Agriculture presented facts and plans of the fight against the Dutch elm disease in this country.

To prevent further introductions of the Dutch elm disease fungus (*Graphium ulmi*), into this country, quarantine regulations governing the importation of burl logs from France and other European countries have been adopted. The logs may continue to enter the country, but they must first be stripped of their bark, to get rid of lurking specimens of the vector beetle, and they must also be subjected to a hot-water treatment long enough to kill the fungus. Crates and other small forms of elm lumber must be entirely free from bark.

A considerable collection of relics of the early settlement at Jamestown, dug up many years ago, has been presented to the U.S. National Museum by MARTIN L. EHMANN of New York.

PERSONAL ITEMS

FERDINAND A. SILCOX, formerly with the U. S. Forest Service and now director of industrial relations for the New York Employing Printers' Association, has been appointed chief of the Forest Service, to succeed the late ROBERT YOUNG STUART.

Dr. W. A. TAYLOR, chief of the Bureau of Plant Industry, U. S. Department of Agriculture, will retire on January 1, 1934. He will be succeeded by KNOWLES A. RYERSON.

Dr. CHARLES GREELEY ABBOT, secretary of the Smithsonian Institution, was given the degree LL.D. by the University of Toronto on October 13.

Dr. F. G. COTTRELL has been appointed consulting chemist of the Tennessee Valley Authority.

Dr. H. H. BENNETT, formerly of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, has been appointed director of the newly created Bureau of Soil Erosion service. Dr. W. C. LOWDERMILK of the U. S. Forest Service has been appointed vice director.

Prof. H. R. TOLLEY of the University of California has been appointed chief of the section of special crops in the Agricultural Adjustment Administration.

Dr. HENRY H. PIXLEY of the College of the City of Detroit has been appointed mathematical economist in the division of economic research and planning of the National Recovery Administration.

Dr. D. BREESE JONES, chief of the protein and nutrition division of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, was elected President of the Washington section of the American Chemical Society, November 9.

EDWARD C. WINGATE, formerly topographic engineer with the U. S. Geological Survey, has been appointed to succeed ERNEST P. LEAVITT, as superintendent of Hawaii National Park.

Dr. GEORGE H. HANSMANN, formerly assistant professor of pathology at the State University of Iowa College of Medicine, has been appointed associate professor at Georgetown University School of Medicine. Dr. JAMES A. GANNON has resigned as associate professor of surgery at Georgetown University, after twenty-five years' association with the department.

Dr. K. S. GIBSON has been appointed chief of the colorimetry section of the optics division of the Bureau of Standards. Dr. GIBSON joined the staff of the Bureau in November, 1916. He succeeds the late I. G. PRIEST.

The following members of the staff of the Bureau of Standards attended the annual meeting of the Optical Society of America, October 19–21, at Buck Hill Falls, Pa.: Dr. B. H. CARROLL, E. C. CRITTENDEN (retiring president), Dr. K. S. GIBSON, Dr. R. S. HUNTER, Dr. D. B. JUDD and Dr. L. B. TUCKERMAN (secretary).

CHARLES E. KELLOGG, of the Biological Survey's Division of Fur Resources, spoke on October 12 at the National Rabbit Convention and Show in Chicago on feeding and other studies being carried on at the United States Rabbit Experiment Station, Fontana, Calif. He supplemented his discussion with charts and graphs.

E. A. PREBLE, senior biologist in the Bureau of Biological Survey, on October 11 discussed *Facts about our fur seals* at the annual meeting of the American Humane Society and associated organizations at Hartford, Conn. He illustrated his address with lantern slides. Mr. PREBLE was a member of the special committee appointed by the Secretary of Commerce in 1914 to study the condition of the fur-seal herds on the Pribilof Islands.

Obituary

OTIS FISHER BLACK, senior biochemist, Bureau of Plant Industry, died suddenly in Washington, October 14. Mr. Black was born in Cambridge, Mass., March 11, 1867. He took his A.B. degree at Harvard in 1891 and served as a fellow at Northwestern University during 1892–94, receiving the degree of Master of Arts in the latter year. He was assistant chemist and instructor at Harvard, 1895–1906, and research assistant in biological chemistry, Harvard Medical School, 1906–09. He entered the Bureau of Plant Industry in 1909 as biochemist and served there continuously until his death.

Mr. Black was also a member of the American Chemical Society, the Society of Biological Chemists, and the American Association for the Advancement of Science.

Dr. ARTHUR POWELL DAVIS, formerly chief engineer and general manager of the East Bay Municipal Utility District, Oakland, California, died in Oakland August 7, 1933, and was buried in Washington, D. C., August 17. Doctor Davis was born in Decatur, Illinois, Feb. 9, 1861. He received his B.S. degree from George Washington University in 1888, his Sc.D. in 1917; his D.E. from Iowa College. He was connected with government irrigation engineering problems for 20 years, first as topographer in 1882, then as hydrologist, and finally as chief engineer and director of the U. S. Reclamation Service until 1923. At various times he served as consulting engineer on Panama Canal problems, on high dam structures in Alaska, Mexico, Puerto Rico, China, Russian Turkestan, and Egypt. Just a few weeks prior to his death, HAROLD L. ICKES, Secretary of the Interior, appointed him a consulting engineer for the entire Boulder Canyon project in recognition of the fact that the present project is based on preliminary plans and reports made by Mr. Davis when he was a government engineer.

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